U. S. FOREST SERVICE

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NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

Folwell Avenue, St. Paul, Minnesota 55101

SELECTING SEED SOURCES OF FOREST TREES FOR THE LAKE STATES — AN INTERIM GUIDE

ABSTRACT. — Summarizes the best available seed source recommendations for the major species used in planting programs in Minnesota, Wisconsin, and Michigan.

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Since the late 1920's many seed source (or provenance) tests have been conducted in the Lake States. From these studies, information has been obtained on seed source differences in growth, survival, pest incidence, and other traits of economic importance. These studies have repeatedly shown that in planting programs, choosing the proper seed source can be just as important as choosing the proper species. For example, trees from the proper jack pine seed source can be 12 to 28 percent taller than those from a local seed source at the end of 10 years. Extrapolating the result to a 40-year rotation, a difference in merchantable per-acre yield between a stand averaging 40 feet tall and one averaging 44 feet tall is about 7 cords. At $4 per cord, there would be a difference in return of $28 per acre, which could well mean the difference between profit and loss of the planting venture (Lundgren and King 1965). Similarly, seed source studies in white spruce indicate that a 25 percent increase in yield is readily possible simply by choosing a well-adapted seed source (Nienstaedt 1968, King and Rudolf 1969, Lester 1969).

The purpose of this paper is to summarize the best available seed source recommendations for the major species used in planting programs in Minnesota, Wisconsin, and Michigan.

BASIS OF RECOMMENDATIONS

Our knowledge of seed source variation for all native Lake States species is far from complete. Many of our studies are still relatively young. These recommendations, therefore, are based on the most conservative interpretation of existing results. This approach may not yield the greatest possible advance in seed and seedling quality, but should, if followed, substantially increase the income derived from plantations. At the minimum, it will prevent serious, large-scale losses due to improper choice of seed sources.

New information on seed sources is continuously being accumulated. But when experimental evidence is lacking, the following guidelines should be used:

1. *Local seed source is safest.*
We define "local" seed as seed collected from natural stands within 50 miles of the *planting site* (not nursery). We have found cases where nonlocal seed sources grow faster and survive as well as the local sources and we will cite several such cases in our recommendations. But we have never found in the Lake States an instance where the nonlocal seed sources had better survival than the local seed source. Survival differences may not appear immediately after final yield than growth differences. Therefore, in the absence of experimental evidence to the contrary, we have recommended the use of seed that is known to have been collected locally.

2. *Do not collect seed from isolated trees.*
Seed produced by isolated individuals of a species often contains a high percentage of self-pollinated seed. In most species, such seed produces inferior seedlings.

3. *Select only the best seedlings from nursery beds.*
Only the tallest, most vigorous seedlings in the nursery should be used for field planting. Faster-growing seedlings in nursery beds often continue to be faster-growing when planted in the field. Culling of up to one-fourth of the seedlings should be practiced in the nursery.

4. *Mix seedlings from local sources with nonlocal sources.*

In instances where tests indicate the superiority of some nonlocal seed source, but where the tests are relatively young or contain few test sources, mix seedlings (not seed) from fast-growing, non-local sources with seedlings from local seed sources (suggested mix: 75 percent nonlocal and 25 percent local seedlings). Mixing seedlings, rather than seed, will ensure that seedlot germination failure or nursery culling does not entirely eliminate either the local or nonlocal seed source. If the seedlings from the nonlocal sources retain their superiority throughout the rotations, stand yield will be increased. On the other hand, if nonlocal stock fails as a result of some extreme climatic occurrence not experienced during the tests, the forest manager will still have a harvestable stand of local stock.

SPECIES RECOMMENDATION

Red Pine *(Pinus resinosa)*

Recommendation: Use local seed.

The results of several provenance tests of red pine indicate that trees from seed collected near the planting site will grow as fast or faster than those from seed collected in other geographic areas (Rudolf 1964). After 30 years in a Minnesota test planting of 69 individual-tree collections of Lake States red pine, trees from the best northern Minnesota seedlots had 19 percent greater height growth than those from the poorest seedlot, and 9 percent better growth than those from the northern Minnesota seedlots (Nienstaedt 1964). There is also evidence here that in Minnesota survival of nonlocal seed sources is not as good as the survival of the local seed source.

Although red pine is relatively uniform, the growth differences are significant. And when coupled with difference in survival, the yield at rotation age may be markedly affected by seed source.

Jack Pine *(Pinus banksiana)*

Recommendations:

1. For Lower Michigan plantings, use seed collected in Lower Michigan.
2. For Wisconsin and Upper Michigan plantings, collect seed from Lower Michigan, and mix the seedlings with seedlings grown from local seed.
3. For Minnesota, collect seed from high-quality stands near the planting site.

Data from Lake States jack pine seed source tests show that the best sources may be as much as 33 percent taller than the poorest sources at the end of 10 years in the field. In 9 of 11 test plantings located throughout Minnesota, Wisconsin and Michigan, trees from the best sources outgrew the local nursery stock by 12 to 28 percent (King 1966).

White Pine *(Pinus strobus)*

Recommendations:

1. For Minnesota plantings, use local seed.
2. For Wisconsin plantings, use seed from stands up to 100 miles south of the planting site.
3. For Michigan plantings: Upper Peninsula, use seed from Lower Michigan; Lower Peninsula, use seed from Tennessee and southern Ontario.

Several seed source tests have indicated that in Lower Michigan seed collected from as far south as Tennessee may produce the fastest-growing seedlings. However, in Minnesota, northern Wisconsin, and Upper Michigan, trees from seed sources a shorter distance south of the planting site did best (King and Nienstaedt 1968, Wright *et al.* 1966).

Scotch Pine *(Pinus sylvestris)*

Recommendations (for Christmas tree production):

1. Spanish seed sources are recommended in Lower Michigan on areas of light-textured soils along Lakes Michigan and Huron.
2. Turkish, Greek, or southern French seed sources are recommended for central Lower Michigan, Upper Michigan, and Wisconsin.
3. Polish, Czechoslovakian, and German seed sources are recommended for Minnesota.

Scotch pine is the most widely planted species for Christmas tree production in the Lake States. Much detailed information is available on tested seed sources for Christmas tree production (Wright *et al.* 1966). There are enough older Scotch pine plantings of good form to indicate that the species does have real potential for timber or pulpwood production, but until the extensive Scotch pine seed source studies now under way mature, we will make no recommendations for timber production.

White Spruce *(Picea glauca)*

Recommendations:

1. Select for seed those trees that exhibit the greatest mean annual height growth (not necessarily the tallest trees in the stand).
2. In Minnesota, Wisconsin, and Michigan, use seed from southeastern Ontario.

In a Wisconsin nursery study that included 28 single-tree seed collections, 4-year-old (2-2) seedlings from the five fastest-growing parents averaged 21 percent greater annual height growth than seedlings from all 28 parents, indicating that it pays to select seed from faster-growing trees (Jeffers 1968).

In a small 29-year-old study in Wisconsin, trees from the best white spruce seed source (Douglas, Ontario) were 11.9 feet (73 percent) taller than those from the South Dakota source and 4.0 feet (17 percent) taller than those from a Wisconsin source.

In a Minnesota planting, trees from the Douglas, Ontario, seed source were 4.1 feet (40 percent) taller than those from the South Dakota source and equal to those from the local source after 19 years (King and Rudolf 1969, Nienstaedt 1968).

Norway Spruce *(Picea abies)*

Recommendation:

1. For Michigan, Wisconsin, and Minnesota, obtain seed from eastern Poland and White Russia (east-central Europe).

On the better, frost-free sites, good Norway spruce seed sources may outproduce white spruce (King and Rudolf 1969, Holst 1963, Slabaugh and Rudolf 1956).

Black Walnut *(Juglans nigra)*

Recommendations: Collect seed from south of the planting site, selecting superior natural stands no more than 100 miles south of the site.

1. In southern Wisconsin, use seed from southern Wisconsin, Iowa, and northern Illinois.
2. In southern Minnesota, use seed collected in southern Minnesota and Iowa.
3. In southern Michigan, use seed from southern Michigan, northern Indiana, and northwest Ohio.[1]

The seed source recommendations for the above species are summarized in table 1.

Plantation Care

In general, we are finding that the superiority of the better seed sources is increased on the better sites. Thus, careful seed source selection should not be considered a substitute for intensified silvicultural methods such as weed control and fertilization. Instead, seed source selection and intensified silvicultural methods should be combined to develop maximum productivity.

SEED LABELING AND CERTIFICATION

Foresters should encourage State seed legislation regarding labeling and certifying forest-tree seed (Society of American Foresters 1963b).

Frequently it is difficult to ascertain that one is purchasing seed from the desired sources or of good

[1] *Personal communication with David Funk, North Central Forest Experiment Station, Carbondale, Illinois. 1969.*

Table 1. — *Summary of seed source recommendations for Lake States tree species*

Species	Planting site: Lower Michigan	Upper Michigan	Minnesota	Wisconsin
	Source of seed			
Red Pine (Pinus resinosa)	Local	Local	Local	Local
Jack Pine (Pinus banksiana)	Local	Lower Michigan (mix with local seedlings)	Local	Lower Michigan (mix with local seedlings)
White Pine (Pinus strobus)	Tennessee and southern Ontario	Lower Michigan	Local	Local (up to 100 miles south of planting site)
Scotch Pine[1/] (Pinus sylvestris)	Spain[2/]	Turkey, Greece, southern France	Poland, Czechoslovakia, or Germany	Turkey, Greece, southern France
White Spruce (Picea glauca)	Southeastern Ontario (50-mile radius of Beachburg)[3/]			
Norway Spruce (Picea abies)	Eastern Poland, White Russia, or other east-central European countries			
Black Walnut[4/] (Juglans nigra)	Southern Michigan, northern Indiana, northwest Ohio		Southern Minnesota, northern Iowa	Southern Wisconsin, Iowa, northern Illinois

1/ For Christmas trees only.
2/ Area bordering Lake Huron and Lake Michigan
3/ In Minnesota, mix with local seedlings.
4/ Do not plant in northern half of Minnesota, Wisconsin, or Michigan.

quality because of a reluctance of dealers and collectors to document this vital information by proper labeling (Society of American Foresters 1963a). Michigan and Minnesota, however, have agricultural seed laws to provide for adequate labeling of forest-tree seed.

Seed certification is a voluntary process and is a common practice with agricultural seeds. A certifying agency (usually the State Crop Improvement Association) attests that the seed meets certain productive standards and is genetically improved. Forest-tree seed certification is not now practiced in the Lake States; however, as more seed orchards are established and come into production, the certification of tree seed is likely to grow rapidly.

SEED PROCUREMENT PLANNING NEEDED

We have assumed that seed from recommended seed sources will be available whenever needed. When the best seed is not available the forest manager can either use inferior seed or defer planting for a few years. Neither of these alternatives is desirable, but under most circumstances deferred planting probably results in smaller loss.

Undoubtedly, the best solution to the seed procurement problem lies in long-term coordinated planning by the forest manager and the nurseryman. With good estimates of future planting stock requirements available, the nurseryman could take full advantage of good seed years and use the best seed storage practices to ensure that adequate supplies of the best are available when needed.

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JAMES P. KING

DAVID H. DAWSON
Principal Plant Geneticists
Rhinelander, Wisconsin

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